CLAIMS

1. A magnetic read head comprising:

a spin valve sensor including:

a ferromagnetic pinned layer that has a magnetic moment;

a pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer structure;

a free layer;

a nonmagnetic conductive spacer layer located between the free layer and the pinned layer;

a capping layer;

the free layer being located between the spacer layer and the capping layer;

the free layer having an oxidized film portion and an unoxidized film portion with the oxidized film portion being located between the unoxidized film portion and the capping layer; and

a copper layer located between the oxidized film portion of the free layer and the capping layer.

2. A magnetic read head as claimed in claim 1 further including:

nonmagnetic nonconductive first and second read gap layers;

the spin valve sensor being located between the first and second read gap layers;

ferromagnetic first and second shield layers; and

the first and second read gap layers being located between the first and second shield layers.

3. A magnetic read head as claimed in claim 2 wherein the unoxidized film portion of the free layer is a nickel iron film and the oxidized film portion of the free layer is a nickel iron oxide film.

4. A magnetic read head as claimed in claim 3 further comprising:

the copper layer being fully oxidized or having an oxidized film portion and an unoxidized film portion.

5. A magnetic read head as claimed in claim 3 wherein the pinning layer is platinum manganese.

6. A magnetic read head as claimed in claim 5 wherein the spin valve sensor further includes:

first and second seed layers with the first seed layer being composed of nickel manganese oxide and the second seed layer being composed of tantalum;

the second seed layer being located between the first seed layer and the pinning layer; and

the first read gap layer being composed of aluminum oxide.

7. A magnetic read head as claimed in claim 6 wherein the copper layer is 4-10 Å thick.

8. A magnetic read head as claimed in claim 7 wherein the capping layer is tantalum.

9. A magnetic read head as claimed in claim 8 wherein the pinned layer is an antiparallel (AP) pinned layer that includes:

ferromagnetic first and second antiparallel (AP) pinned films with the first AP pinned film interfacing the pinning layer and the second AP pinned film interfacing the spacer layer; and

an antiparallel (AP) coupling film located between and interfacing the first and second AP pinned films.

10. A magnetic read head as claimed in claim 2 wherein the unoxidized film portion of the free layer is a cobalt iron film and the oxidized film portion of the free layer is a cobalt iron oxide film.

11. A magnetic read head as claimed in claim 10 wherein the free layer further includes a nickel iron film wherein the cobalt iron film is located between the spacer layer and the nickel iron film.

12. A magnetic read head as claimed in claim 11 wherein the free layer further includes a nickel iron oxide film located between the nickel iron film and the cobalt iron film.

13. A magnetic head assembly having an air bearing surface (ABS), comprising:

a write head including:

ferromagnetic first and second pole piece layers that have a yoke portion located between a pole tip portion and a back gap portion;

a nonmagnetic write gap layer located between the pole tip portions of the first and second pole piece layers;

an insulation stack with at least one coil layer embedded therein located between the yoke portions of the first and second pole piece layers; and

the first and second pole piece layers being connected at their back gap portions; and

a read head including:

a spin valve sensor;

nonmagnetic nonconductive first and second read gap layers;

the spin valve sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second gap layers being located between the first shield layer and the first pole piece layer; and

the spin valve sensor including:

a ferromagnetic pinned layer that has a magnetic moment;

a pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer structure;

a free layer;

a nonmagnetic conductive spacer layer located between the free layer and the pinned layer;

a capping layer;

the free layer being located between the spacer layer and the capping layer;

the free layer having an oxidized film portion and an unoxidized film portion with the oxidized film portion being located between the unoxidized film portion and the capping layer; and

a copper layer located between the oxidized film portion of the free layer and the capping layer.

14. A magnetic head assembly as claimed in claim 13 including:

a ferromagnetic second shield layer;

a nonmagnetic isolation layer located between the second shield layer and the first pole piece layer.

15. A magnetic head assembly as claimed in claim 13 wherein the unoxidized film portion of the free layer is a nickel iron film and the oxidized film portion of the free layer is a nickel iron oxide film.

16. A magnetic head assembly as claimed in claim 15 further comprising:

the copper layer is fully oxidized or has an oxidized film portion and an unoxidized film portion.

17. A magnetic head assembly as claimed in claim 15 wherein the pinning layer is platinum manganese.

18. A magnetic head assembly as claimed in claim 17 wherein the spin valve sensor further includes:

first and second seed layers with the first seed layer being composed of nickel manganese oxide and the second seed layer being composed of tantalum;

the second seed layer being located between the first seed layer and the pinning layer; and

the first read gap layer being composed of aluminum oxide.

19. A magnetic head assembly as claimed in claim 18 wherein the copper layer is 4-10 Å thick.

20. A magnetic head assembly as claimed in claim 19 wherein the capping layer is tantalum.

21. A magnetic head assembly as claimed in claim 20 wherein the pinned layer is an antiparallel (AP) pinned layer that includes:

ferromagnetic first and second antiparallel (AP) pinned films with the first AP pinned film interfacing the pinning layer and the second AP pinned film interfacing the spacer layer; and

an antiparallel (AP) coupling film located between and interfacing the first and second AP pinned films.

22. A magnetic disk drive that includes at least one magnetic head assembly which has a write head, a read head and an air bearing surface (ABS), comprising:

the write head including:

ferromagnetic first and second pole piece layers that have a yoke portion located between a pole tip portion and a back gap portion;

a nonmagnetic write gap layer located between the pole tip portions of the first and second pole piece layers;

an insulation stack with at least one coil layer embedded therein located between the yoke portions of the first and second pole piece layers; and

the first and second pole piece layers being connected at their back gap portions; and

the read head including:

a spin valve sensor;

nonmagnetic nonconductive first and second read gap layers;

the spin valve sensor being located between the first and second read gap layers;

a ferromagnetic first shield layer; and

the first and second read gap layers being located between the first shield layer and the first pole piece layer; and

the spin valve sensor including:

a ferromagnetic pinned layer that has a magnetic moment;

a pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer structure;

a free layer;

a nonmagnetic conductive spacer layer located between the free layer and the pinned layer;

a capping layer;

the free layer being located between the spacer layer and the capping layer;

the free layer having an oxidized film portion and an unoxidized film portion with the oxidized film portion being located between the unoxidized film portion and the capping layer; and

a copper layer located between the oxidized film portion of the free layer and the capping layer;

a housing;

a magnetic disk rotatably supported in the housing;

a support mounted in the housing for supporting the magnetic head assembly with said ABS facing the magnetic disk so that the magnetic head assembly is in a transducing relationship with the magnetic disk;

a spindle motor for rotating the magnetic disk;

an actuator positioning means connected to the support for moving the magnetic head to multiple positions with respect to said magnetic disk; and

a processor connected to the magnetic head, to the spindle motor and to the actuator for exchanging signals with the magnetic head, for controlling movement of the magnetic disk and for controlling the position of the magnetic head.

23. A magnetic disk drive as claimed in claim 22 including:

a ferromagnetic second shield layer;

a nonmagnetic isolation layer located between the second shield layer and the first pole piece layer.

24. A magnetic disk drive as claimed in claim 22 wherein the unoxidized film portion of the free layer is a nickel iron film and the oxidized film portion of the free layer is a nickel iron oxide film.

25. A magnetic disk drive as claimed in claim 24 further comprising:

the copper layer being fully oxidized or having an oxidized film portion and an unoxidized film portion.

26. A magnetic disk drive as claimed in claim 24 wherein the pinning layer is platinum manganese.

27. A magnetic disk drive as claimed in claim 26 wherein the spin valve sensor further includes:

first and second seed layers with the first seed layer being composed of nickel manganese oxide and the second seed layer being composed of tantalum;

the second seed layer being located between the first seed layer and the pinning layer; and

the first read gap layer being composed of aluminum oxide.

28. A magnetic disk drive as claimed in claim 27 wherein the copper layer is 4-10 Å thick.

29. A magnetic disk drive as claimed in claim 28 wherein the capping layer is tantalum.

30. A magnetic disk drive as claimed in claim 29 wherein the pinned layer is an antiparallel (AP) pinned layer that includes:

ferromagnetic first and second antiparallel (AP) pinned films with the first AP pinned film interfacing the pinning layer and the second AP pinned film interfacing the spacer layer; and

an antiparallel (AP) coupling film located between and interfacing the first and second AP pinned films.

31. A method of making a magnetic read head which has an air bearing surface (ABS), comprising the steps of:

making a spin valve sensor including the steps of:

forming a ferromagnetic pinned layer that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer;

forming a free layer;

forming a nonmagnetic conductive spacer layer between the free layer and the pinned layer;

forming a capping layer with the free layer being located between the spacer layer and the capping layer;

forming the free layer with an oxidized film portion and an unoxidized film portion with the oxidized film portion being located between the unoxidized film portion and the capping layer; and

forming a copper layer between the oxidized film portion of the free layer and the capping layer.

32. A method as claimed in claim 31 further including the steps of:

forming nonmagnetic nonconductive first and second read gap layers;

forming the spin valve sensor between the first and second read gap layers;

forming ferromagnetic first and second shield layers; and

forming the first and second read gap layers between the first and second shield layers.

33. A method as claimed in claim 32 wherein the unoxidized film portion of the free layer is formed as a nickel iron film and the oxidized film portion of the free layer is formed as a nickel iron oxide film.

34. A method as claimed in claim 33 further including forming the copper layer fully oxidized or with an oxidized film portion and an unoxidized film portion.

35. A method as claimed in claim 33 wherein the pinning layer is formed of platinum manganese.

36. A method as claimed in claim 35 wherein the making of the spin valve sensor further includes the steps of:

forming first and second seed layers with the first seed layer composed of nickel manganese oxide and the second seed layer composed of tantalum with the second seed layer being located between the first seed layer and the pinning layer; and

forming the first read gap layer of aluminum oxide.

37. A method as claimed in claim 36 wherein the copper layer is formed 4-10 Å thick.

38. A method as claimed in claim 37 wherein the capping layer is formed of tantalum.

39. A method as claimed in claim 38 wherein a forming of the pinned layer comprises the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned films with the first AP film interfacing the pinning layer; and

forming an antiparallel (AP) coupling film between the first and second AP films.

40. A method as claimed in claim 32 wherein the unoxidized film portion of the free layer is formed as a cobalt iron film and the oxidized film portion of the free layer is formed as a cobalt iron oxide film.

41. A method as claimed in claim 40 wherein the free layer is further formed with a nickel iron film with the cobalt iron film being located between the spacer layer and the nickel iron film.

42. A method as claimed in claim 41 wherein the free layer further includes forming a nickel iron oxide film between the nickel iron film and the cobalt iron film.

43. A method of making magnetic head assembly that has an air bearing surface (ABS), comprising the steps of:

making a write head including the steps of:

forming ferromagnetic first and second pole piece layers in pole tip, yoke and back gap regions wherein the yoke region is located between the pole tip and back gap regions;

forming a nonmagnetic nonconductive write gap layer between the first and second pole piece layers in the pole tip region;

forming an insulation stack with at least one coil layer embedded therein between the first and second pole piece layers in the yoke region; and

connecting the first and pole piece layers at said back gap region; and

making a read head including the steps of:

forming nonmagnetic nonconductive first and second read gap layers;

forming a spin valve sensor between the first and second read gap layers;

forming the first and second read gap layers between the first shield layer and the first pole piece layer; and

a making of the spin valve sensor comprising the steps of:

forming a ferromagnetic pinned layer that has a magnetic moment;

forming a pinning layer exchange coupled to the pinned layer for pinning the magnetic moment of the pinned layer;

forming a free layer;

forming a nonmagnetic conductive spacer layer between the free layer and the pinned layer;

forming a capping layer with the free layer being located between the spacer layer and the capping layer;

forming the free layer with an oxidized film portion and an unoxidized film portion with the oxidized film portion being located between the unoxidized film portion and the capping layer; and

forming a copper layer between the oxidized film portion of the free layer and the capping layer.

44. A method as claimed in claim 43 including the steps of:

forming a ferromagnetic second shield layer; and

forming a nonmagnetic isolation layer between the second shield layer and the first pole piece layer.

45. A method as claimed in claim 43 wherein the unoxidized film portion of the free layer is formed as a nickel iron film and the oxidized film portion of the free layer is formed as a nickel iron oxide film.

46. A method as claimed in claim 45 further including forming the copper layer fully oxidized or with an oxidized film portion and an unoxidized film portion.

47. A method as claimed in claim 45 wherein the pinning layer is formed of platinum manganese.

48. A method as claimed in claim 47 wherein the making of the spin valve sensor further includes the steps of:

forming first and second seed layers with the first seed layer composed of nickel manganese oxide and the second seed layer composed of tantalum with the second seed layer being located between the first seed layer and the pinning layer; and

forming the first read gap layer of aluminum oxide.

49. A method as claimed in claim 48 wherein the copper layer is formed 4-10 Å thick.

50. A method as claimed in claim 49 wherein the capping layer is formed of tantalum.

51. A method as claimed in claim 50 wherein a forming of the pinned layer comprises the steps of:

forming ferromagnetic first and second antiparallel (AP) pinned films with the first AP film interfacing the pinning layer; and

forming an antiparallel (AP) coupling film between the first and second AP films.